THE TELEGRAPHIC JOURNAL.

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A WRONG WITHOUT A REMEDY.

THOSE of the telegram-receiving public whose confidence in the laws of their country has been encouraged by a belief that a fundamental principle of those laws is that there is no wrong without a remedy, will be somewhat startled by the recent decision of the Court of Appeal at Westminster, in the case of *Dickson* v. *Reuter's Telegram Company Limited*. Since the transfer of the telegraph system of the United Kingdom into the hands of the State, the number of decisions of the courts as to the liability of telegraph companies to the public has been but few; but we believe that the responsibility which those companies owe to the senders of telegrams for negligence is pretty clearly made out. What their liability and duties are to the recipients of despatches has not however been hitherto settled or even considered. A decision has, in the case we have mentioned, been arrived at, and it is a very clear and a most unpleasant one, at any rate, to the public.

The facts of that case are briefly as follows:—The plaintiff, a merchant at Valparaiso, received a telegram through the defendants, purporting to come from a London firm, and addressed to him. This telegram ordered of him a large consignment of barley for shipment to London. The plaintiff bought the barley and shipped it; but to his intense disgust he afterwards found that the telegram was not intended for him. For this blunder, which was entirely due to the negligence of the defendant company, the latter would, it is clear, be answerable to the sender of the telegram; but fortunately for them the price of barley in the London market had fallen in the interim, and the sender of the telegram was only too glad to disclaim any liability on his part to take the barley from a person of whom he had never ordered it. The unfortunate plaintiff, however, was not so circumstanced, for he lost nearly £3,000 by the fall; and thinking naturally enough that, as his loss was due to the telegraph company, they were liable for it, he therefore brought his action against them for the amount. The telegraph company, admitting for the sake of argument their negligence, nevertheless denied that they were under any liability to the plaintiff, or to any other recipient of their telegrams, and this contention the Common Pleas Division of the High Court and the Court of Appeal have unanimously and without hesitation held to be a good one.

We think our readers will admit that we were justified in our preliminary statement that the decision would startle them; but we also think that a consideration of the judgments of the two courts will make it clear that in the present state of the law this decision is entirely correct, and founded on perfectly sound legal principles. Whether the law should be allowed to remain as it is, is however, quite another question, and one of the gravest importance.

The fundamental principle on which the judgments rest is, that no man is responsible to another for negligence in any matter, to whom he does not owe a duty in that matter imposed by contract or law. This principle was admitted on all hands to be an absolute one, and the main energies of the plaintiff's counsel were directed towards endeavouring to make out that there was a duty imposed by law on the company towards the plaintiff. He admitted that there was none by contract. In support of his contention he quoted a case from the American reports, which is so curious, that we must mention it here. The case was this:—An order was sent to a florist by telegram for "Two hand bouquets;" this, by an error which telegraphists will readily appreciate, was received as "Two hund bouquets"; the receiving clerk, for clearness (?), added the letters r, e, d, to the muddled word, and the florist consequently received an order for "Two hundred bouquets." This order he, with some difficulty, executed, much to the surprise of the gentleman who sent the more modest demand. The American court held that, from the nature of the telegraph company's business, there was an obligation imposed on them towards the recipient of the message to be accurate in the delivering of it, and gave judgment for the florist. This authority was of course in no way binding on our courts, and was not expressly referred to in the judgment; but the grounds on which the learned judges dissented from it are sufficiently clear. They say, that except that the statements of the telegraph company are made with a greater degree of solemnity, so to speak, their case is analogous to that of a man who makes a statement to another; that if every statement made in good faith, but erroneous in fact, which causes damage, be actionable, no one would venture to open his mouth. But is not this greater solemnity, the whole point of the case? and although we admit that legally speaking it may not alter the case, still should it not be made to do so by legislative enactment.

Telegraph companies will, no doubt, profit by this

decision in more ways than one, as, besides the immunity from actions which they will obtain by it, the recipients will for safety's sake pay to have messages repeated. But should they be put to this expense?

No doubt there is no relation by "contract" between telegraph companies and the recipient of messages, as there is between them and the sender who pays them, and no doubt judges would not be justified in setting aside plain and valuable general principles to meet cases of hardship; but the law has already imposed many duties on us which are averse to general principles, but admirable in the special cases they are intended to meet. Carriers, for example, are liable to the consignees of goods, the carriage of which is already paid by the consignor, and may not the legislature fitly say that the mere fact that he is not a "contracting" party shall not deprive one who incurs immense loss at the hands of a telegraph company by receiving a message erroneous through their negligence, of the remedy which he who sends it has? The remedy need go no further, and we entirely fail to appreciate the remark which was made in the Common Pleas Division and the Court of Appeal, that if the recipient, who had not contracted, had a remedy, so would anyone else who might be injured, and that if the plaintiff could recover in the case in question, he could also do so if his loss had been caused by a spurious telegram being sent by a swindler.

If there is reason in the sender having a remedy, it seems to us that, apart from the present legal considerations, there is equal reason in the recipient having one; and just as the former cannot recover unless he shows that his loss was occasioned by the fault of the company, so exactly with the latter.

LIGHTHOUSE ILLUMINATION BY ELECTRICITY.

THE increasing scientific labours of the Corporation of the Trinity House to reduce the dangers of our rocky coast by the erection of splendid lighthouses, have been worthily supplemented by their persevering efforts to obtain a light of the very highest illuminating power, so that the lighthouses can be seen at night from a greater distance than formerly.

The latest discoveries made in electric science have enabled the Elder Brethren to adopt a light of unequalled brilliancy and intensity—we refer to the electric light—which has been so improved as to have become at the present time a thoroughly reliable and steadfast beacon.

The early machines for the production of the electric light, such as Holmes' and the Alliance machines, both of which are magneto-electric and give alternating currents, have many inherent defects, but also the merit of being the first electric apparatus used for lighthouse illumination, and they have proved by their uninterrupted working for upwards of two years that lighting by electricity is a complete success.

One serious disadvantage of these magneto-electric machines is, that they require more motive power than dynamo machines, besides which, the strength of the permanent magnets becomes weakened in the course of time, and a still larger expenditure of steam power is then required to obtain the same intensity of light, whereby a still greater cost is entailed.

Machines of various types have since been devised, some giving alternate currents, others continuous; of the latter class, the Siemens and the Gramme have been proved by the Trinity House trials to give good results. These dynamo-electric machines are not only free from the faults of magneto machines, such as the weakening of the magnets already mentioned, the destruction of the commutators by sparks and the conversion of a portion of the current strength into heat, which, with continuous working of the machines, is sufficient to destroy the insulation of the wires, but their first cost and expense of working are considerably less.

The results, in fact, obtained from these two systems of electric light apparatus were so important and so far exceeded anything previously done, that in the winter of last year the Trinity House authorities commenced their series of careful and exhaustive experiments for the purpose of thoroughly testing the merits of various systems of electric light machines.

We have already in this Journal published the leading parts of the "Correspondence and Reports on the Subject of Comparative Trials of Electric Lights at the South Foreland," and we will merely remark here that the results of the trials proved so conclusively the superiority of the Siemens' machines that the Corporation of the Trinity House adopted it for lighthouse illumination, and gave orders for the erection of the necessary apparatus in the Lizard's lighthouses.

The accompanying figures show the form of the machine and lamp to be employed. Fig. 1 is a perspective view of the dynamo-electric machine. The electric current is produced by the rotation of a conductor of insulated copper wire. This wire is coiled in several lengths, and with many convolutions, upon a cylinder in such a manner that each single convolution describes the perimeter of the longitudinal section of the cylinder, which encloses a stationary core of soft iron prolonged at both ends through the bearings of the wire cylinder and extending to the standards. Around the wire cylinder, and in close proximity to it, are curved iron bars, so arranged as only to allow enough space for the cylinder to revolve freely between them. These curved iron bars are prolongations of the cores of the electro-magnets, and the sides of these cores are connected by being screwed to the iron standards. A continuous circuit is formed by the coils of the electro-magnets and the wires of the cylinder, which latter rotates in a feeble magnetic field formed by residual magnetism. In this way a current is excited in the wires of the cylindrical

FIG. 1.

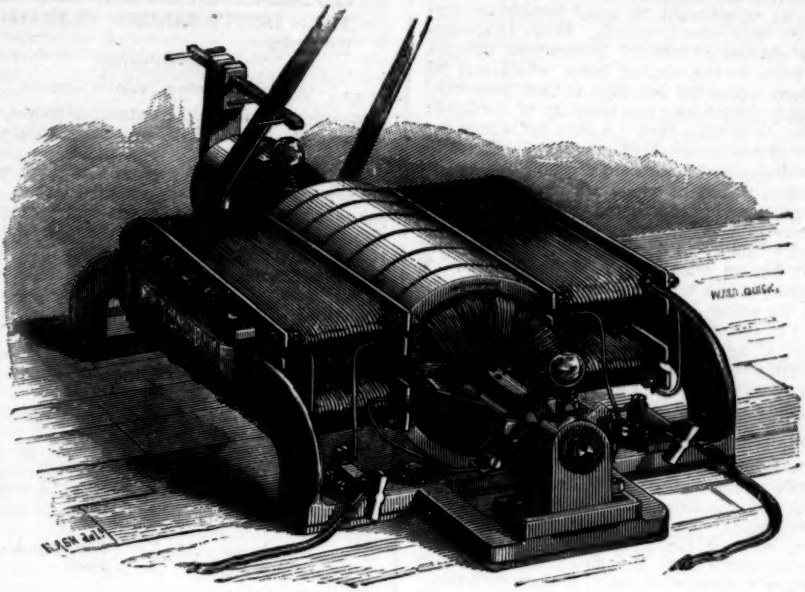


FIG. 2.

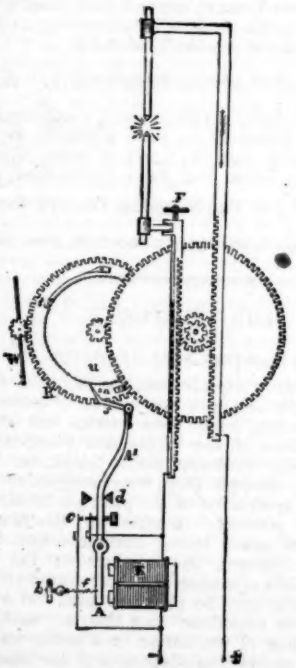


FIG. 3.

armature, passes into the magnet coils, and increases the intensity of the magnetic field and of the current, which latter is collected on metal brushes in communication with two terminals. From these terminals a continuous current is conveyed through leading wires to the electric lamp, which may be placed from 400 to 500 feet from the machine without sensibly diminishing the intensity of the light; even a longer distance than this does not reduce the illuminating power when leading wires of sufficiently small conducting resistance are used.

The lamp, details of which are shown in fig. 2, is self-regulating, but is actuated without clockwork, the absence of which does away with a source of failure and liability to derangement. The electro-magnet E has an armature A opposite its poles. A spiral spring *f*, the tension of which can be regulated by the screw *b*, withdraws the armature from the poles of the electro-magnet, and brings its prolongation, A′, against the stops *d*. When a current of sufficient strength to overcome the tension of the spring *f*, passes through the coils of the electro-magnet, the armature is attracted and makes contact at C, which diverts the current from the electro-magnet coils into the shunt. The release of the armature from the poles of the electro-magnet re-opens the contact at C; the armature is again attracted, and this action is repeated during the use of the machine.

When, therefore, the carbon points are so close that the resistance of the electric arc is small enough to maintain a current in the coils just sufficiently strong to overcome the tension of the spring *f*, the armature A, A′, begins to oscillate, and continues to vibrate while the current remains of the same intensity. The spring pawl *s*, at the end of the arm A′, oscillating with the arm, moves a fine-toothed ratchet wheel *u*, in gear, by means of a train of wheels and pinions, with the racks of the carbon holders, and resists the gravitating tendency of the upper carbon-holder, while slowly distancing the carbons; increase of resistance results, the current gets weaker, the armature ceases to oscillate, and again rests upon the stop *d*.

In this position the spring pawl *s*, by its inclined face bearing against a pin *n*, is released from the teeth of the ratchet-wheel *u*; the preponderating weight of the upper carbon-holder now comes into play, and the carbons are carried towards each other, and the spur-pinion on the spindle of the ratchet-wheel revolves now in the opposite direction; the decrease of length, and consequently of resistance of the electric arc gives rise to increased current strength; the armature again oscillates, and the carbons are distanced as before. The speed at which the carbons approach is regulated by the fly W, the driving wheel R, of which turns loosely on the axis of the ratchet-wheel, and is coupled to this wheel by the spring detent *t*, this detent acting only when the carbons approach. The regulation of this lamp is exceedingly simple, as the only thing requiring attention is the spring *f*, which is adjusted once for all to the strength of current given by the machine. For many purposes the light is concentrated by a silvered parabolic reflector, which, with the lamp, is mounted on a stand (*see* fig. 3) with ball and socket joint, so that the light can be directed to any point.

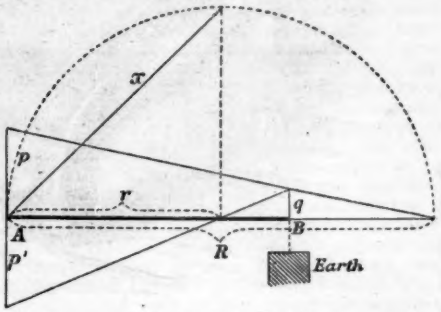
(*To be continued.*)

NEW FORMULA FOR CALCULATING THE COPPER-RESISTANCE DURING ELECTRIC DISTURBANCES (EARTH-CURRENTS).

By CHR. DRESING,
Of the Great Northern Telegraph Company.

THE following is with constant reference to the *ordinary bridge-method* of measuring copper-resistance.

A B is a cable put to earth at B, through which is flowing an earth-current (potential q at B) of supposed constant or nearly constant strength and direction. p and p' represent the potential of the testing-battery at A, when the one or the other pole is put to line.



By drawing *geometrically*, in the usual manner as shown, *the mean* between the two lines r and R (*i.e.*, the two resistances obtained in measuring, as indicated by the fall of potential), we have

$\frac{r}{x} = \frac{x}{R}$, or $x^2 = r.R$, consequently $x = \sqrt{r.R}$.

This expression gives the same or about the same result as Mr. Schwendler's more elaborate formula (Clark & Sabine, page 29); and in cases of heavy earth-currents when the *direct arithmetical mean* $\left(x = \frac{r + R}{2}\right)$ is simply useless, the new formula $(x = \sqrt{r.R})$ gives the true or about the true value.

THE TELEPHONE.

EXPERIMENTS NEAR LIVERPOOL.

SOME interesting experiments, the result of which may materially improve our modes of communication in mines, have been carried out at the Prescot Colliery of the Wigan and Whiston Coal Company, with Professor Bell's telephone. The experiments, though they were suggestive of a much wider application of the principle involved in them, were primarily intended to illustrate the possibility of much better communication being established between the workers in the most distant portions of a mine and those connected with the mine who may be above ground. A matter perhaps more important than this, as tending to show the state of ventilation in a mine, was also illustrated—namely, an adaptation of the telephone for obtaining above ground the record of a self-

acting airnometer or air measurer. The experiments naturally attracted considerable interest amongst those connected with collieries, and probably those who attended from different mines would represent an annual production of coal of not less than eight million tons. Among those who witnessed the experiments were Professor Sir Wm. Thomson, F.R.S., &c.; Mr. A. Le Neve Foster, and Messrs. H. Hall and J. L. Hedley, Government Inspectors of Mines.

For the experiments about 600 yards of ordinary insulated wire were used, the ends in one instance being at the bottom of the pit, while the other ends, to which the tubes or trumpet-like orifices, which resemble ordinary stethoscopes, were attached, were brought into the office of the company, which is at some considerable distance from the pit's mouth. While one of the colliery inspectors of the Government, Mr. Hall, and others went to the bottom of the pit, the majority of those who had attended remained in the office. The apparatus was first used for the purpose of communication with those in the mine, and the success was complete, the acquaintances above and below promptly recognising each other by the sound of the voice, and carrying on such an animated communication that almost simultaneously with the transmission of each observation down to those in the mine by means of one wire, their replies came up through the other wire, so that the persons in the office found themselves at once so fully *en rapport* with their friends at a distance that a general feeling of hilarity overspread the company. Even the cheering of the colliers at a distance from the instrument was distinctly heard, and those at the instrument below stated that they could hear, besides the messages which were sent directly down, the buzz of animated conversation in the office overhead. The instrument was then tested in relation to the principal practical purpose to which it is just now intended to be applied, namely—the indicating overhead of the airnometer below. The airnometer which was adopted for the purpose is the ordinary one in use, and is the invention of Mr. Hall, the inspector. In this apparatus, by means of a delicately constructed windmill in minature, the rate of the current of air in the passages of a mine may be tested. At present, however, that can only be read off the register which is attached to it by those in the mine. The application of the telephone to this enables the registry to be tested at any moment by a person above the mine, so that the chance of deceit is done away with, it being a common practice to remedy insufficient ventilation only when the men have warning that some person in authority is about to descend the shaft. The registration overhead is simply attained by having the air measurer always connected with a telephone, and so adjusted that after a fixed number of revolutions the instrument may act on a spring which vibrates against the telephone and setting it in action, enables the overseer overhead to know at what rate of current the air is running in the mine. This was done to the complete satisfaction of Mr. Hall and his brother inspector and those best acquainted with the requirements of the case.

Professor Thomson, in the course of the proceedings, accomplished the novel feat of giving a short lecture on the telephone, at one and the same time, to Mr. Hall, who was in the mine, and the company who were in the office. The Professor had hardly uttered his opening sentence, saying, "I am just going to give an explanation, in a word or two, of the principle of the telephone—which you, Mr. Hall, I presume, understand perfectly?" than the words "Yes, yes," from Mr. Hall were transmitted through the receiving wire with all the animation of "Hear, hears," at a public meeting. Professor Thomson, in the course of his explanation, stated how delighted he was with the great improvement which had been made in the instrument since it was tested in a crude state by the inventor and himself at the Philadelphia Exhibition before the Emperor of Brazil. He alluded to other inventions of the kind, particularly Riess' telephone, and pointed out that whereas formerly before the continuity of the electricity was secured by the completed electric circuit, though a musical note might be reproduced in the correct pitch, owing to the breaks in the communication the timbre was lost. Thus every note was heard like a trumpet sound only. In the present instrument something of the timbre was also conveyed. Bell's telephone was, in fact, as great an advance beyond the others as the syphon recorder was an improvement upon the preceding electric instruments. The instrument, in fact, produced at one end a motion similar to that at the other, but not an equal motion. When they succeeded in doing the latter, then the sound would be reproduced as loudly as it was made.

Mr. Hall said the invention as regarded mines was the most important they had had for fifty or sixty years.

The success of the experiments were acknowledged by several other practical persons.

ANNUAL REPORT OF THE NEW ZEALAND TELEGRAPHIC DEPARTMENT.

THE thirteenth annual report, presented by Mr. George Maclean, Commissioner of Telegraphs, shews that the total earnings of the department for the year 1876—77, exclusive of the value of General Government telegrams, amount to £65,644 15s. 3d., being £2,929 4s. 11d., in excess of the receipts of last year.

The number of telegrams transmitted during the year was 1,124,432, being an increase over the previous year of 73,346. Comparing this increase with that of the increase of the year 1875—76 over the year 1874—75, the increased number transmitted falls short by some 60,612. Taking into account the value of the General Government telegrams, the total earnings of the department for the year amounted to £82,669 4s., and this exceeds the expenditure in maintenance of lines and stations by £1,384 5s. 2d. The cost of maintenance of stations for the year was £63,353 10s. 10d., and of lines £17,931 8s. The former item shows an increased expenditure over the previous year of £1,656 16s. 5d., and the latter a decrease of £3,143 0s. 8d.

The number of telegrams transmitted during the year, as compared with the number of letters posted during the same period, shows that 20·29 telegrams were sent for every 100 letters. The comparative number for the previous year was 22·21. The

proportion for the present year is therefore somewhat less, but the fact that the number of letters shows an increase of 809,047 has to be taken into consideration.

The number of money-order telegrams sent during the year was 12,336, representing a value of £55,322 2s. 6d., being an increase of 1,624 messages, and £6,333 5s. 3d., as compared with the previous year.

The commission collected by the Post Office on these transactions amounts to £1,554 12s. 8d., and after deducting £616 16s., due to the Telegraph Department as fees on telegrams, there remains to the credit of the Post Office £937 16s. 8d., being within a fraction of 1·7 per cent. upon the total amount transmitted.

During the year, 105 miles of line, carrying 176 miles of wire, have been erected.

The number of stations open to the public on the 30th June was 155, 15 of which were opened during the past year, seven being in the North Island and eight in the South Island.

The cost per mile for maintenance of line was £5 12s. 11d., the extent of line maintained being 3,174 miles.

On the 30th June, 1877, 3,259 miles of line, carrying 7,423 miles of wire, were in circuit, showing an increased mileage upon the previous year of line, 105 miles; and wire, 176.

Since the date of the last report, the duplex system of telegraphy has been further extended between Christchurch and Dunedin, Government Buildings and Blenheim, aud Blenheim and Dunedin. This latter section is about 500 miles in length, and is one of the longest circuits upon which the system has yet been tried without translation.

A line from Hawera to New Plymouth, which was in course of construction at the date of the last report, has been completed.

A line from Reefton to Westport, which was completed on the 19th June last, is 50 miles in length, 28 miles being new line. The poles on this line are sawn from heart of totara, and for the better protection of the line an extra bush clearing of one chain wide has been made throughout.

Lines from Palmerston North to Fielding, 12 miles in length, and from Waiwera line from Warkworth, 16 miles in length, have also been completed.

From Kawakawa to Mongonui, a distance of 153 miles, a line is in course of construction.

A large number of lines have also been substantially repaired.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

A SPECIAL general meeting was held at the Institute of Civil Engineers, on Wednesday 31st ulto., Prof. Abel, F.R.S., President, in the chair, for the purpose of hearing a paper read by Prof. Graham Bell, on the subject of his researches in "Electric Telephony." There was a crowded attendance, including several prominent men of science.

Prof. Bell, in commencing his paper, said that for many years his attention had been directed to the subject of sound and telephony, his first experiments in this direction having been made when assisting his father, Mr. A. Melville Bell, of Edinburgh, in a research into the mechanism of speech. The latter gentleman had invented a very accurate method of representing the positions of the various organs in forming sounds, and together with his son, carried on a series of investigations into the musical relation of English and foreign vowel sounds. When we whisper vowel sounds, each vowel seems to have a particular pitch; and in coming to a determination of the pitch of each vowel sound, Mr. Graham Bell hit upon an expedient which he at the time believed to be original. It consisted in vibrating various tuning forks in front of the mouth and noting the fork represented by each vowel. He afterwards learnt that this had been already done by Helmholtz, who had also devised means of artificially reproducing vowel sounds by the aid of electric currents.

Subsequently, in Canada, Professor Bell carried on a series of experiments, seeking to reproduce the results achieved by Helmholtz, but without success. He next turned his attention to the transmission of musical notes. It seemed feasible that the piano could be played electrically, and that not only single notes, but also chords could be transmitted by having a contact-breaker to make and break circuit, and an electro-magnet under each string. It was this end he had in view when he commenced his real investigation of telephony; and although the above arrangement was never actually adopted, the idea led to experiments which eventually resulted in more perfect methods.

A study of the modifications of electric currents which could be employed for purposes of telephony showed that there are six species of currents competent to produce vibrations at the end of a wire; viz., (1) the *intermittent*, a series of single currents, either positive or negative; (2) the intermittent with reversals; (3) the *pulsatory*, or single current with a series of equal increments of current strength; (4) the same with reversals; (5) the *undulatory*, or wave-form of single current; (6) the same with reversals. Of these the undulatory with reversals was the form of current selected as the best suited to purposes of sound-transmission.

The undulatory or wave-form of electric current having been adopted as being competent to transmit super-imposed vibrations, the next question to be solved was, how to convey and register varying *intensities*—in other words, to record *pitch*, or frequency and *amplitude* simultaneously—the key to an articulating telephone. This had been done to some extent by Helmholtz, who varied the size of the air-cavity employed with his tuning forks.

The first form of articulating telephone devised by Professor Bell, was a kind of harp, composed of short iron rods, somewhat after the fashion of the teeth of a musical-box, which could vibrate before the poles of a series of electro-magnets. When a rod was plucked, it would, by its disturbance of the magnetic field, induce currents of electricity in the coils of the electro-magnet, and the energy with which it was plucked would determine the amplitude of vibration, and, in consequence, the intensity of the induced electric impulses. This instrument was, however, a purely theoretical one, and was never constructed.

At the time of these first essays, Professor Bell, who had now removed to Boston, was chiefly employed in applying his father's system of teaching deaf-mutes to articulate. It is well known that deaf-mutes are not dumb in consequence of any deficiency or deformity of their vocal organs, and that if the proper positions of these organs can be visually explained to them, they can be taught to copy those positions and so to articulate. This system has been successfully applied in

America, where, at the present time, there are over two thousand deaf-mutes who can converse perfectly.

In connection with this work, experiments were undertaken with a view to representing the vibrations of sound optically; and, acting upon a suggestion of Dr. Blake, an aurist of Boston, Prof. Bell employed the human ear itself to record the vibrations set up by vocal sounds. An ear was moistened with glycerine and water, and a stylus of hay attached firmly to the incus, the stapes having been removed; vowel sounds were then sung into the ear, and were graphically reproduced by a beautiful series of curves drawn by the pointer upon a curved plate of smoked glass which was drawn rapidly under it. The vibrations due to tuning-forks were also observed and registered in the same way. Collodion was then poured over the plate, and became incorporated with the film of lamp-black; the curves obtained could thus be transferred at pleasure.

It has been seen that an undulatory current could be produced by a vibrating spring. Now, in examining the mechanism of the human ear, Professor Bell was struck with the enormous disproportion between the mass of the vibrating membrane and that of the bones thrown into vibration by it. Then came the question: If bones so disproportionately heavy can be agitated by a membrane so light, could not a spring attached to the membrane be caused to vibrate and so to reproduce articulate sounds?

Setting himself to solve this query, he devised a new form of telephone, consisting of a tightly stretched membrane closing an air-cavity, to which was attached a spring free to vibrate before an electro-magnet. (The reader will probably be reminded of Reiss' telephone. But he will also remember that this was a "make-and-break" arrangement used in conjunction with a battery, and that the receiving instrument was incompetent to reproduce amplitude.) Having constructed instruments of this form, Prof. Bell and a friend endeavoured to converse through them, but at first without success. The vibrating spring was then replaced by a small piece of flat spring glued firmly to the membrane, and now the first successful experiment was performed. Sending his friend to an adjoining building, Prof. Bell asked the question, "Do you understand what I say?" and presently he was delighted to hear the little piece of steel spring reply, "Yes, I understand you perfectly." This instrument, however, was not a great success; and it was found impossible to carry on a conversation by its means. By continual repetitions of a word or phrase it was possible, after a time, to understand what was meant, but this was all. Further experiments were then undertaken, which led to the membrane being discarded and a diaphragm of thin iron employed in its place.

Space will not permit mention to be made here of all the successive stages through which Prof. Bell's telephone has passed, or the various forms it has assumed, most of which are already familiar to our readers. But there are one or two points which were noticed by Prof. Bell in the course of his experiments, and which are, perhaps, worth referring to. He noticed, for instance, that distinct sounds proceeded from straight pieces of iron, retort-carbon, graphite, &c., when intermittent currents were sent through them. He also repeated Page's experiments, and found that the tones emitted by electro-magnets were not due wholly to the iron core but partly to the helix, which, in fact, could be made to emit sounds when the core was removed. Passing intermittent currents through the primary wire of an induction coil, and connecting the ends of the secondary to various forms of condensers, such as brass plates or tin-foil, insulated with paper, &c., he succeeded in producing musical notes, thus anticipating Mr. Cromwell Varley.

He also noticed that when he and a friend, standing on insulating stools, grasped hands, and received shocks from a Ruhmkorf coil, audible sounds proceeded from their joined hands. In fact, he could, by presenting his knuckle to any part of his friend, draw sounds from him.

The most recent form assumed by Professor Bell's articulating telephone requires no explanation here, as it is now so well known. The most remarkable point in connection with it is the ease with which vibrations are taken up alike by diaphragms of vastly different dimensions. Pieces of boiler-plate, two or three feet in diameter, and $\frac{1}{8}$ inch thick, were found to serve equally as well as the small thin diaphragms. As a still more crucial experiment, Professor Bell employed a piece of inch board, a foot square, to which he firmly attached, on the side nearest the magnet, a piece of iron plate, 5 inches diameter, and $\frac{1}{32}$ in. thick, the mouth-piece and air cavity being entirely removed. On the outside of this formidable diaphragm, Professor Bell spoke to a friend three miles distant, and found that he could carry on a conversation through it with ease; a result which, as Professor Bell remarked, seems to force the conclusion that the effective vibrations are, to some extent, at least, molecular, and not merely mechanical.

The horse-shoe form of magnet has also been employed, both poles being presented to the diaphragm, and equally good results have been obtained.

In laboratory experiments articulate speech has been transmitted through resistances of as much as 60,000 ohms. Through an arrangement of resistance coils and condensers, intended to imitate the effect of an Atlantic cable, musical notes have been sent, but not, of course, speech. It may be mentioned that conversation has been carried on through the Dartmouth-Guernsey cable, a distance of 70 miles.

The greatest obstacle to the employment of the telephone on aerial lines is the interference due to currents induced in the telephone circuit by working currents in parallel wires on the same posts.

Professor Bell's lecture, which was illustrated by numerous diagrams, elicited frequent applause; and at its close, he received quite an ovation. During its course, he generously acknowledged his indebtedness to Professors Peirce and Blake, Dr. Channing, and other American friends, from whom he has received much valuable assistance and advice. One of Professor Blake's experiments is especially worthy of mention. Employing a rod of soft iron, six feet in length, instead of a short steel magnet, he found that it answered well when held in the line of the dipping needle, but that the sounds became fainter as the rod was removed from that position, and ceased altogether when it was at right angles to the plane of the magnetic meridian.

A cordial vote of thanks, proposed by Mr. Latimer Clark and seconded by Mr. W. H. Preece, was unanimously passed; and thus terminated one of the most successful meetings which the Society has held since its foundation.

PHYSICAL SOCIETY—3rd NOVEMBER, 1877.

Prof. G. C. FOSTER, President, in the chair.

The following candidate was elected a member of the Society—Alexander Jesseman.

Prof. MCLEOD described some experiments he has recently made to determine the exact number of vibrations of tuning forks by means of the apparatus he exhibited to the Society on the 28th of April last, and which was designed for determining slight variations in the speed of machinery or other analogous purposes. He has studied a new set just received from

Kœnig, and his results exhibit a remarkable concordance. The extreme results in the worst set of observations, on a fork of 256 complete vibrations, only differing by 0·005 per cent.; and in a good set they agreed within 0·00078 per cent. Examining the series from 256 to 512, he found them in all cases to give nearly 0·5 of a vibration more than was anticipated, but as this variation may be due to a difference between the temperature and that at which they were adjusted, he is waiting to ascertain what this was. He considers that the manner in which the fork is held has an effect on its vibrations, and he hopes to be able to get some information as to the effect of temperature on elasticity.

Dr. HUGGINS exhibited some artificial gems recently prepared by M. Feil, the well-known glass manufacturer of Paris. He has succeeded in crystallizing stones of the corundum class, and rubies as well as a topaz and emerald were exhibited. Dr. Huggins believes that the colour is imparted by small quantities of metallic oxides, and that the mass is mixed with boracic acid, and maintained in a fused condition for a considerable period. M. Feil hopes to obtain larger stones by maintaining the heat constant for several weeks consecutively.

Dr. LODGE then read a communication from Profs. Ayrton and Perry, of the Imperial College, Japan, in continuation of one read to the Society on the 26th of May last, on "Ice as an Electrolyte," and since published in the *Philosophical Magazine*. The experiments therein described led them to expect a very sudden rise in the specific inductive capacity as the temperature of the ice increased through zero and it became water. Recent results have shown that, though rapid, this increase is not as great as they anticipated. Referring to Prof. Clerk Maxwell's theory comparing electro-magnetic disturbances with light vibrations, they point out that it supposes a non-conducting medium. But they showed in a former paper that no di-electric can be considered non-conducting, hence they conclude that the measured specific inductive capacity can never be even approximately equal to the square of the index of refraction.

Prof. FOSTER mentioned that he recently had occasion to collect as many results as possible on specific inductive capacity and refractive index, and he found that where these figures were low, the agreement with the law was fairly close, but with greater values the inductive capacity and the square of the refractive index separate very rapidly.

Prof. GUTHRIE described a simple means for showing the interference between two plane waves by means of two long cords vibrating side by side. If a vibration of considerable amplitude be imparted to them, and the plane in which they travel be carefully examined, two faint black lines will be seen which cross and re-cross each other more rapidly as the cords are less and less in unison, and with perfect unison remain stationary.

Review.

Journals of the Society of Telegraph Engineers. Nos. XV. and XVI., Vol. V.; Nos. XVII. and XVIII., Vol. VI. (Double Numbers). (E. & F. Spon, London and New York.)

THE two double numbers of this journal, which have just been issued, are most pleasing contrasts compared with the first number of the journal as regards the amount of information contained in their pages. They show well the wonderful progress the Society has made since its commencement, and they compare most favourably with the proceedings of other societies.

Nos. XV. and XVI. contain Mr. Latimer Clark's paper "On Clamond's Thermo-Electric Battery," Mr. Jamieson's paper "On a New Form of Lightning Protector for Telegraph Lines and Apparatus," "On a Form of Lightning Conductor used on the State Lines of France," and "Bertsch's Lightning Guards," by John Aylmer.

Amongst the "Original Communications" we have "Notes on Electrolytic Polarisation" and "Lightning Conductors," by W. E. Ayrton and John Perry. "Experiment to Show the Direction in which the Electric Spark tends to Travel," by Captain R. C. Scott, R.E. "Observations on a Thunderstorm which passed over Para on the 27th Dec., 1876," by C. B. Slater. "On Corrections to be applied to the apparent Resistance of the Conductor and Insulator of a Telegraph Line when determined in the usual way by Wheatstone's Bridge," by C. Hockin, M.A. "On the Magnitude of the Signals received through a Submarine Cable with various connections at each end, and the best resistance for the Recording Instrument," also by Mr. Hockin. A most interesting verbatim copy of Professor Œrsted's Original Communication, in which he announced his discovery of Electro-Magnetism: "*Experimenta circa effectum conflictus Electrici in Acum Magneticum*," and an English translation of the same. A Memoir of Professor Œrsted, by L. C. Masden, and "On Duplex Telegraphy," by J. J. Fahie.

Nos. XVII. and XVIII. contain Professor Abel's Inaugural Address for the year 1877. "On Shunts and their application to Electro-metric and Telegraphic Purposes," by W. H. Preece, M.I.C.E., Vice-President. "On Fire Telegraphs," by R. von Fischer-Treuenfeld, F.R.G.S. "On the Automatic Step-by-Step Type-Printing Telegraph Apparatus used by the Exchange Telegraph Company," by F. Higgins, and a Description of the Autokinetic System in application to Fire Alarms. "On Underground Telegraphs," by Willoughby Smith. "On Underground Telegraphs in France," by John Aylmer. "On Quadruplex Telegraphy," by G. B. Prescott, and a Description of M. Ailhaud's System for Duplex Working in operation on the Marseilles-Algiers Cable.

Amongst the "Original Communications and Abstracts" we have "Note on Electro-Magnets employed in Telegraphy," by M. Emile Lacoine; "On Electro-Magnets for use in Telegraphy," also by M. Emile Lacoine; "Telegraphy in New Zealand," by Mr. W. H. Floyd; "The Importance of a General System of Simultaneous Observations of Atmospheric Electricity," and "A Duplex Partial-Earth Test," by W. E. Ayrton and John Perry.

Full reports of the discussions on the different papers are given, and engravings of the various diagrams employed to illustrate the papers make the volumes very complete.

Notes.

PROFESSOR GRAHAM BELL'S lecture at the first meeting of the Society of Telegraph Engineers for the winter, was equally admirable as a scientific exposition of telephony and an example of public elocution. It is in keeping that the man, who has not only made deaf mutes but even inanimate metal to articulate, should speak so well himself. There was a large, appreciative, and distinguished assembly of hearers present. At the

end of the lecture, when the strains of Burns's "Auld lang syne" were evoked from the telephones on the table, we were agreeably reminded that the Inventor and the Poet are countrymen. Ninety years ago the inspired ploughman wrote the following patriotic lines:

> Even then a wish—I mind its power—
> A wish that to my latest hour
> Shall strongly heave my breast—
> That I, for poor auld Scotland's sake,
> Some usefu' plan, or book could make,
> Or sing a sang at least.
> The rough bur-thistle spreading wide
> Among the bearded bear,
> I turned the weeder-clips aside
> And spared the symbol dear."

We may imagine how the shade of Burns, if some of the eminent spiritualists at the meeting could have raised it, would have been gratified at hearing one of his famous "sangs" so commemorated by the "usefu' plan" of a compatriot.

THE India Rubber, Gutta Percha, and Telegraph Works Company have acquired the exclusive right to manufacture Bell's speaking telephone in this country, and notify that legal proceedings will be taken "against all infringers of the patent whether makers, sellers, or users."

WE beg to call the attention of telegraph engineers seeking employment to the advertisement of the Midland Railway Company, which appears at the end of this number of our Journal.

MR. ANTHONY TROLLOPE has made a contribution to our Telegraphic *belles lettres*, which, although yet very sparing in quantity are superior in quality to the American literature of the same kind. Some months ago a paper by Mr. Trollope descriptive of the life and routine of the government female telegraphists at St. Martin's-le-Grand, appeared in "Good Words," and on the lines furnished him by his practical study of this subject, he has woven a pleasant little story not unredeemed from the commonplace. It forms part of "Good Cheer," the Christmas number of "Good Words," and is called "The Telegraph Girl."

THE s.s. *Seine*, which was despatched to Newfoundland on the 29th of August last, to assist the s.s. *Minia* of the Telegraph Construction and Maintenance Company in repairing the 1866 Atlantic Cable, returned to Gravesend on Sunday October 28th. After repairing the first fault at about 130 miles from Heart's Content, the *Seine* arrived at lat. 51° 25′ N. and long. 34° 42′ W., on the 19th September; but out of thirty three days that she remained thereabout she could only work eight, and even during these, continuous repairing was impossible. The cable was hooked five times, but was broken by the rough sea before reaching the surface, and further operations were abandoned. The cable appeared in very good condition, and the engineer in charge of the repairing expedition, expressed his confidence in the possibility of repairing it in fine weather, his opinion being based on the condition of one and a half miles of cable recovered in 1,820 fathoms of water.

THE Western and Brazilian Telegraph Company announce that the s.s. *Hibernia*, of the Telegraph Construction and Maintenance Company, sailed from the Thames on Monday, October 29th, having on board the new cable designed to restore communication between Pernambuco and Para, and to touch at the intermediate port of Maranham.

AT the general meeting of the West Coast of America Telegraph Company, held on Thursday, November 1st, it was stated that the Aria-Mollendo section of the company's cables had been broken on May 9th, last, by an earthquake, and repaired on the 24th of the same month, and that the La Serana-Valparaiso section had been interrupted by an earthquake on July 26th, and would be repaired immediately after the arrival of the company's repairing ship out there. The traffic between La Serena and Valparaiso was being conveyed meanwhile by government land line. It was also stated that the time now occupied in the transmission of messages from Lima to London varied from twelve to thirty-six hours.

THE Eastern Extension Telegraph Company recently notified that the Singapore-Penang section had been repaired, and direct communication thus restored between the Straits settlements, Java, and Australasia; but this route has since been interrupted again.

A SPECIAL division of the forthcoming International Exhibition at Paris will be devoted to electricity, and an opportunity will thus be provided for testing the varied means of electric lighting.

MAGNETIC PROPERTIES OF NICKEL AND COBALT.—M. Hankel finds that with feeble currents the magnetic power of nickel is equal to that of soft iron; but with strong currents it is comparatively feeble. The magnetic power of cobalt with both strong and feeble currents is much less than that of nickel and soft iron.

MAGNETIC PROPERTY OF HYDROGENIUM.—It is known that palladium is feebly magnetic, and that hydrogenium is feebly diamagnetic, and when the late Professor Graham succeeded in "occluding" hydrogen and palladium, he believed that the resulting alloy would be at least less magnetic than before, but to his surprise he found it much more magnetic. M. Blondlot has inquired into the anomaly, and found results in all cases opposed to those of Graham. He finds that palladium charged with hydrogen is much less magnetic that when in the pure state. It is thought that Graham's materials have been impure.

DIMENSIONS OF ELECTRO-MAGNETS.—M. Du Moncel formulates his results as to the best dimensions to give to electro-magnets as follows:—1. The dimensions of

an electro-magnet ought essentially to depend on the electro-motive force, which will act upon it, and on the resistance of the circuit in which it will be placed. When the circuit is long, and the electro-motive force feeble, the electro-magnet ought to be long, and of small diameter. When, on the contary, the circuit is short, and the electro-motive force intense, the core ought to be above all of a large diameter. 2. For circuits of equal resistance the diameters of electro-magnets established in them ought to be proportional to the electro-motive forces. 3. With equal electro-motive forces the diameters ought to be inversely as the square root of the resistances in circuit, including the resistance of the battery. 4. With equal diameters, the electro-motive forces ought to be proportional to the square roots of the resistances of the circuits.

M. TROUVÉ, Paris, has made some improvements in the contact-breaker or trembler of induction coils. They are designed to secure various rates of vibration of the trembler, so as to obtain intermittent induction currents of different periods. He effects his purpose by varying at will the length of the vibrating stem of the trembler, and limiting its range of vibration according to a scale on the instrument. M. Trouvé's new apparatus, although not rivalling in precision the *Apparat de Cabinet* of MM. Trouvé and Onimus, is said to be very convenient for ordinary use.

EXPLANATION OF FIRE-BALLS—M. Planté seeks in the foregoing experiments of his an explanation of the *foudre globulaire* or "fire-ball." They show that with a sufficient quantity and tension of electricity we can obtain the electric light in a globular form. He therefore thinks that this manifestation of the lightning discharge is due to an abundant flow of electricity in the dynamic state in which great quantity and potential are united. Those particular cases wherein the fire-ball is seen to move and to stop, are explained by the motion or rest of a column of humid air, strongly electrified and invisible, which serves for an electrode. In order to imitate this effect it suffices to oscillate the platinum electrode in the above experiments, pendulum fashion, over the water, or a metallic surface, when a little fire-ball is seen to move over the surface opposed. We may add that this explanation of the fire-ball has been advanced before by Mr. Cromwell F. Varley.

A CORRESPONDENT in *Nature* states that on the evening of Sunday, Oct. 14, the night of the late gale, about 6.50 p.m, while walking in a south-easterly direction through the village of Lower Tooting, he saw what appeared to be a huge ball of green fire suddenly fall from the sky. Its size, vivid colour, and the strange noiselessness of its fall were very striking. It seemed to come from a part of the sky near Jupiter, and to fall not a hundred yards from the observer. On the same evening, about twenty minutes later, a similar "fire-ball" was seen at Brixton.

THE INSTITUTION OF CIVIL ENGINEERS.—In the circulars announcing the commencement of another session, the sixtieth year since its establishment, attention has again been directed to the importance of there being an unfailing supply for reading at the weekly meetings of original communications calculated to raise useful discussions. As an aid in this direction a list of subjects for papers has just been issued, prefaced by a statement of the funds at the disposal of the council for rewarding the authors of meritorious communications. It has also been pointed out that it is equally essential that the "minutes of proceedings" should be made the depository of other original communications which from various circumstances are deemed better suited for publication alone than for reading and discussion at the meetings. The volumes likewise contain "abstracts of papers in foreign transactions and periodicals," the aim in the latter case being to present a succint *résumé* of the current engineering literature of all countries. The opening meeting of the session, 1877-78, took place on Tuesday, the 13th instant, when a "Review of the Progress of Steam Shipping, during the last quarter of a century," by Mr. Alfred Holt, M. Inst. C. E., of Liverpool, was read and discussed.

M. A. THENARD, when employing the current of a magneto-electric machine to deposit copper, found that the total quantities of copper deposited increased with the number of baths through which the current passed. Each bath contained plates of copper as electrodes, and was charged with solution of sulphate of copper, to which some sulphuric acid was added. The baths were arranged in series like the cells of a battery. There is, perhaps, nothing new in this record, but it was found that the *quality* of the deposit was better the larger the number of baths employed, although the quantity of copper deposited on each anode decreased with the decrease of their number. The quantities, of course, depends entirely upon the electric energy expended; but the quality of the deposit depends on other and not so well-known circumstances.

INFLUENCE OF FOREIGN MATERIALS IN CARBON POINTS.—M. Gaugain finds that calcium phosphate introduced to the extent of five per cent., is completely decomposed and the oxide partly reduced; the resulting fumes of phosphoric anhydride and lime render the light twice as brilliant as that produced by ordinary gas carbon poles. Silica reduces the conductability and also the illuminating power of the carbon points. Magnesia, magnesium borate, and phosphate were tried. The salts were decomposed and reduced, and, although an increase of light was given, it was not so marked as in the case of the calcium phosphate. Alumina and aluminium silicate were tried, but required a stronger current for decomposition. The aluminium

vapour burned with a feebly luminous flame of a bluish colour. M. Gaugain abandoned his experiments because the flame and smoke seemed an insuperable objection to the introduction of these lights. M. Carré has continued these experiments and found that potash and soda double the length of the electric arc and render it silent, increasing the intensity of the light in the ratio 1·25 : 1. Lime, magnesia, strontia, iron, and antimony augment the light in the ratios 1·3, 1·5, 1·6, and 1·7 : 1. The carbon *wicks* made by reducing pure homogenous charcoal to powder, thoroughly cleansed and mixed with the salt, moistened with a little gum, and pressed through a wire-drawing machine by hydraulic pressure, are found to be very superior to those obtained from gas carbon. The terminals are very tenacious and rigid, and being perfectly homogenous the light obtained is not liable to variation, nor do they explode owing to enclosed gases when ignited.

TRAFFIC RECEIPTS.

1877.	Anglo-American Co.	Brazilian Sub. Co.	Cuba Sub. Co.	Direct Spanish Co.	Direct U.S. Co.	Eastern Co.	Eastern Ex. Co.	Gt. Northern Co.	Indo-Euro. Co.	Mediterranean Ex. Co.	Submarine Co.	West Coast America Co.	Western and Brazilian Co.	West India Co.
	£	£	£	£	£	£	£	£	£	£	£	£	£	£
JAN. ...	37,780	11,469	2,311	983	13,530	42,580	24,147	12,663	... ...	... ...	9,668	2,533[b]	10,100	4,058
FEB. ...	32,330	11,606	2,214	784	15,520	35,050	19,645	12,800	... ...	... ...	8,624	2,980[c]	11,026	3,870
MARCH ...	18,880	11,258	3,025	913	8,110	35,491	22,886	16,115	... ...	... ...	9,915	3,128[d]	11,643	5,854
APRIL ...	18,980	11,539	4,706	1,011	6,930	39,861	23,068	16,151	... ...	... ...	11,324	2,362[e]	10,295	7,729
MAY ...	45,420	12,251	4,109	997	17,370	46,309	25,445	18,427	... ...	... ...	11,048	2,179[f]	10,534	7,508
JUNE ..	40,040	9,742	3,295	887	15,260	45,477	24,126	19,663	... ...	... ...	9,960	4,025[g] / 2,225[h]	10,522	5,541
JULY ...	38,790	9,226	2,959	834	14,820	42,713	22,224	19,187	... ...	... ...	9,943	1,925	7,881	4,980
AUGUST...	41,170	9,407	2,728	804	15,700	40,428	25,371	17,998	... ...	... ...	9,683	2,025	8,610	*4,367
SEPT. ...	43,230	9,253	*2,500	836	15,940	35,440	22,113	18,445	... ...	... ...	10,029	1,625	9,504	*3,976
OCT. ..	49,510	11,260	*3,000	945	13,486	37,402	21,388	21,210	... ...	... ...	10,823	2,225	10,037	*5,647

* Estimated. *b*, four weeks ending 13th January. *c*, four weeks ending 13th February. *d*, four weeks ending 10th March. *e*, four weeks ending 7th April. *f*, four weeks ending 5th May. *g*, four weeks ending 2nd June. *h*, four weeks ending 30th June.

City Notes.

Old Broad Street, Nov. 14th, 1877.

THE first general meeting of the new Direct United States Cable Company will take place on Friday. As a matter of course, a congratulatory report has been prepared, and will doubtless be carried unanimously. Reference is made to the "much mistaken criticism, founded upon a complete misapprehension of motives and intentions," which were "created by the exercise by the old company of its statutory rights;" and it is declared that "the directors have not done, nor have they ever contemplated doing, any act not strictly within the inherent power of every company formed under the Limited Liability Statutes; or in derogation of any engagement of the old company communicated to its members and the public which it was competent for the promoters to make." The directors, we learn, are gratified in being able to state that the holders of upwards of sixty thousand shares have exchanged their shares with the new company, or "not dissented,"—we should like to know how many of the sixty thousand have "not dissented,"—and it is stated that proceedings are pending "for determining the sum to be paid, for the purchase of the interests of the few remaining dissentients who gave notice requiring the liquidators to purchase their shares." Again, we should be interested to know precisely how large the interests held by the "few remaining dissentients" are. Perhaps something answering these points will come out at the meeting. That Mr. Pender is still not quite free from misgivings may be gathered from the fifth paragraph of the report. "Notwithstanding the efforts of the directors to fulfil in perfect good faith all the engagements of the old company towards associated companies, objections to the assignment of the agreements with the Dominion Telegraph Company of Canada have been raised, and damage claimed by that company for an alleged breach of such agreements by reason of the operation of the reconstruction." The shareholders must not, however, be too uneasy about the proceedings hanging over the company, for, "the directors are advised that the claim put forward is untenable; but as they are carrying out the terms of these agreements,"—are they?—"they trust that the differences of form existing between the two companies will be amicably and satisfactorily settled." Besides, and this will surely be sufficient to convince every one,

"the directors have given the American and Dominion Governments assurances that the introductory professions of the old company as to an independent, reliable, and cheap service for the public, will be faithfully carried out." We can safely leave it to the American and Dominion Governments to estimate the value of these assurances. To some people the paragraph may read almost like an intentional piece of satire. But then to some people the entire report will partake of that nature. We shall refer to that document, and not improbably to the accompanying balance sheet and revenue account, in our next number. Meanwhile, we observe that Messrs. Siemens thus are put down as creditors of the old company to the extent of £30,800. It is stated that the company has counter-claims upon Messrs. Siemens, while Messrs. Siemens claim a further sum of £5,000. We believe the company will find that Messrs. Siemens do not mean to be satisfied with anything less than a cheque for the full amount of their account.

Mr. William Abbott was, it appears, dissatisfied with the ordinary newspaper report of the West India and Panama meeting. The ordinary newspaper report did not include Mr. Abbott's speech on the occasion, and did not name the "loud cheers" which were accorded to Mr. Abbott when that gentleman resumed his seat. Nothing, however, that Mr. Abbott advanced has altered our conviction that the chairman was perfectly right in refusing to give way on the subject of quarterly dividends, even to Mr. Abbott's persuasive eloquence. We are glad to see that Mr. Abbott had the good sense to refrain from mentioning this point in his monthly circular. He is there content to contrast the West India and Panama with the Western and Brazilian Company, and we really think the contrast is permissible. Up to the time we write, the affairs of the latter company were as unpromising as its worst enemies could wish.

The report of the Eastern Extension Australian and China Telegraph Company for the half-year ending June 30 states that the total earnings amounted to £140,436, the expenses being £48,417. The available balance is £92,019, but deducting two interim dividends of 1½ per cent., there remain only £13,299. This sum, it is announced, will be carried forward. Nearly £28,000 were appropriated towards payment of the Rangoon-Penang Cable. It is not stated what will be the entire cost of the cable.

The Eastern Extension Telegraph Company notify that their Singapore-Penang Cable is now repaired. Direct telegraphic communication is thus reached with the Straits Settlements, Java, and Australia. We also observe that the screw steamer *Hibernia*, belonging to the Telegraph Construction and Maintenance Company, has sailed from London with the necessary new cable to restore communication between Pernambuco and Para, touching at Maranham.

At the ordinary general meeting of the Brazilian Submarine Telegraph Company, which was taking place when we were at press with our last issue, the chairman said he could not help referring to the connection of the company with the Western and Brazilian Company. We do not wonder that Viscount Monck spoke of it as a point of "an unsatisfactory character." The Western and Brazilian is not a company one would choose to be allied with just now under any circumstances; and as the shareholders of the Brazilian are actually losing by the connection, it is irritating to find that no change in the arrangement between the companies can be made before next June. Lord Monck mentioned that he had received some letters from shareholders complaining that five per cent. was a miserably small sum when the risky nature of the undertaking was considered; but he replied—and we think his reply was most effective—that while he would agree with that, if five per cent. exhausted all their earnings, the consistent policy of the directors had been to pay a small dividend, and to lay by a reserve fund which would ensure the permanence of the dividend. In spite of, as usual, certain protests to the chairman's reasoning, the shareholders manifested their good sense by adopting the report.

The two events which have occurred during the past fortnight in the railway world have been the collapse of the amalgamation scheme between the Great Northern and Midland Companies and the Manchester, Sheffield, and Lincolnshire Company, and the issue of the prospectus of the Metropolitan Inner Circle Company. There is no disputing the fact that the announcement of a rupture of negotiations between the Great Northern and the Midland, and the Sheffield Companies was a greater surprise, if not to the general, to the financial public, than the announcement that the negotiations were in progress. In truth, until last Friday evening, every one supposed that, granting the consent of Parliament—about which there would, admittedly, have been some difficulty, the union of the companies had ceased to be a matter of doubt. The result of the sudden and apparently complete failure of the negotiations, will certainly be that henceforth any statement concerning railway amalgamation will not only be received with distrust, but with positive disbelief. As usual, it appears that the company which would have gained most by amalgamation was instrumental in causing the rupture. We are bound to conclude that the directors of the Sheffield, like the directors of the Great Eastern some little time ago, fancied that by holding out they could obtain better terms. They have found out their mistake; but the shareholders will probably not be satisfied with a simple admission of that kind. They will insist upon learning why the gentlemen in whose hands their property is, were unwilling to accept what most people consider was a very equitable proposal. It is not likely that the Great Northern and Midland Companies will allow the matter to be reopened.

With regard to the scheme for the completion of the inner circle of the underground railway system, it is apparent that the public can only gain by it being carried out. The Metropolitan and District Railways, with many faults, have been a great boon to hundreds of thousands of persons, and the extension of the railway from Mansion House to Aldgate will add to the value of the system. It is more difficult to decide whether the scheme can be recommended as an investment. As a rule, however, enterprises which justly have the support of the public, if they do not pay good dividends for some years, are in the end a source of profit to shareholders. The District Railway, at first anything but prosperous, is making steady progress, financially. It is true that the directors of the Metropolitan Railway Company do not approve of the inner circle scheme, and have even, as it seems to us, gone out of their way to give it an unkind word. But the circumstance that the shareholders of the District, rather than those of the Metropolitan Company, will benefit by it, may, perhaps, help to explain this incident. For a long time, it was expected that the District and Metropolitan Companies would unite, but the chances of the combination are now remote. As we have already intimated, railway "amalgamation" will, at all events for a long period, be regarded with something more than suspicion. Nevertheless, the underground railways will never reach the climax of prosperity until they are all controlled by one board of directors, and one staff of managers.

General Science Columns.

[By adding these columns on "General Science" to the TELEGRAPHIC JOURNAL, we hope to increase its usefulness. Some of the discoveries and inventions we shall have to chronicle will be found to have a more or less direct bearing on telegraphy, and others, although wholly unconnected with it, will perhaps be none the less interesting, especially to our numerous subscribers abroad whose other sources for such information may be scanty. The columns will contain the leading scientific advances which take place as time goes on. Gentlemen willing to contribute original articles to them are requested to communicate by letter with the "Manager," TELEGRAPHIC JOURNAL, 10, Paternoster Row, E.C.]

RAINBAND IN THE SOLAR SPECTRUM.—By means of a small pocket spectroscope Professor Piazzi Smyth, of Edinburgh, finds it possible to make rapid observations on the proportion of moisture in the atmosphere, and to form a fairly correct opinion as to the chances of coming rain. Professor Smyth has recently made public the results of his observations made on a voyage from Edinburgh to Lisbon. The mode of operation is as follows.—The spectrum of daylight is examined through the pocket spectroscope, which has a very fine clean slit, and as it is necessary to look through a considerable thickness of air the spectroscope is directed to the sky close to the horizon. If the atmosphere is very moist the aqueous vapour gives rise to a band of dark lines, near the red end of the spectrum, which has been called the *rainband*. The more highly charged the air is with moisture the darker seems the band, whose tint also deepens in passing from colder to warmer climates.

AURORÆ BOREALES.—From a recent comparison of the observations made on "northern lights" at 128 stations in Finland, M. Fritz deduces several interesting results. The observations extended over a period of nine years, from 1846 to 1855, and were limited to the winter months from August to April. Of the 2,035 days of the period of observation it appears that 1,107 were days of auroræ. This must not, however, be taken as the total number of displays, since there are clear nights in Finland when no observations are possible. Of these 212 were visible only in Finland, 101 were visible in Finland and other parts of Europe, and 794 were visible in Finland and other parts of Europe, and in America. During the same period there were 958 displays visible in America which were not visible in Finland. It follows from these observations that some auroræ are of a very limited extent and due to local causes. It also appears from the Finland data that with the frequency of the displays their intensity also increases. The lines or zones of equal frequency of the displays have been called *isochasms*. The isochasm of greatest frequency irregularly encircles the earth, passing through Barrow Point, the north-west point of North America, Great Slave Lake, Nairn on the Coast of Labrador, South of Cape Farewell in Greenland, the Farœ Islands, North Cape in Norway, Nova Zembla, Cape Tcheljuskin, and Nischne-Kolymsk, to Barrow Point, thus following roughly to the northern limit of trees. The other isochasms are more or less parallel with this line. The line for one aurora per year passes through Bordeaux, Switzerland, Krakau, Moscow, Tobolsk, Baikal, Sea of Ochotsk, S. Aleutes, N. California, Mouths of the Mississippi, to Bordeaux. Almost exactly, if not quite exactly, with the isochasm of greatest frequency runs the line at which the aurora is seen overhead. North of this line the aurora is seen to the south, and south of it the aurora is seen to the north. From all stations the aurora is seen in a direction nearly normal to that line and the system of isochasms.

IT is well known that the main stream of the Nile is supplied by the great equatorial lakes of Africa, and that the annual inundations are caused by the inrush of torrent water laden with soil from the fertile slopes of the Abyssinian plateau in July, August, and September. This silt is now for the most part being deposited in the bed of the Mediterranean, where it is gradually forming a new delta similar to the delta already formed at the river's mouth. Sir Samuel Baker has written to the *Times* suggesting a plan by which not only the water of the Nile but the mud which it now deposits wastefully in the sea, may be turned to good account as a fertiliser of the deserts of Nubia, Libya, and the Soudan. He proposes by suitable engineering works to divert a portion of the Nile flood-water into these deserts, where it can deposit its rich sediment on the sands, and also irrigate them so as to transform them from a desert into "cotton-fields that would render England independent of America." This could be effected by having suitable dams and sluices at different points of the Nile, say at the Cataracts. These dams and sluices, by enabling craft to pass the Cataracts, would also render the Nile navigable from the Mediterranean to Gondokoro, a space of 29 deg. of latitude.

A NEW contrivance for rendering the numbers of houses visible by night is becoming general in Paris. It consists of a hollow triangular prism about nine inches long, two of whose sides are formed of panes of blue glass, on which the number of the house is picked out in white. This prism-shaped lamp-glass rests against the front of the house, so that the two sides with the numbers on them can be plainly seen by the passers-by. In the interior of the prism is a gas jet, fed by a pipe from the house. Householders on the Avenue de l'Opera have been obliged to supply this mode of numbering at their own expense on the houses they are building; and the municipal authorities have introduced it on some 450 of the municipal establishments, schools, police offices, fire-brigade offices, &c.

FOR many years past attempts have been made to wash the auriferous black sands on the seashore of Northern California and Oregon for the gold dust they contain, but hitherto with very indifferent success. These sands extend from the beach under ocean far below low water; but they shift with the tide, and a

"claim" yielding a rich percentage of gold to-day may be swamped with barren sand to-morrow. A new machine for working the sand has been successfully worked lately, and it is expected that these sands will become in future an almost inexhaustible source of gold. After a month's trial the new machine, at a cost of 1,300 dollars, extracted 12,000 dollars worth of gold from twenty tons of sand.

METEORITES.—In twelve falls of meteorites during the last eighteen years in the United States, of which specimens have been collected, eight falls have taken place in the prairie regions of the West, on a surface not over one-eighth of the extent of the United States, a fact which is not to be explained on the supposition that that region is more populated than the rest of the country, and consequently furnishes more observers.

The meteorites which fell at Rochester, Warrenton, and Cynthiana, in the United States, have been analysed. The Rochester meteor had been apparently dissipated in small fragments, of which that which was picked up at Rochester did not weigh more than 400 grammes. Its texture was found to be globular; 46·8 per cent. of its substance was soluble in water, and 53·2 per cent. insoluble. Its specific gravity was 3·55, and it contained minute particles of nickeliferous iron. The Warrenton meteorite weighed from five to seven kilogrammes; its specific gravity was 3·47, and it also contained a few grains of nickeliferous iron. Its chemical constitution was found as follows:—

Periodite	76·0
Bronzite and pyroxen	18·0
Nickeliferous iron	2·0
Troilite	3·5
Chrome iron	0·5
	100·0

The Cynthiana meteorite weighed six kilogrammes, with a specific gravity the same as the Warrenton meteorite. Its constitution was found as follows:—

Periodite	50·0
Bronzite	38·0
Nickeliferous iron	6·0
Troilite	5·5
Chrome iron	0·52
	100·02

M. Schiaparelli has ascertained that the velocity of meteors varies from 1,600 to 72,000 metres per second. Taking 50,000 metres as the average velocity of a meteorite, M. Govi calculates that a meteor projected vertically downwards into the atmosphere with this initial velocity would, on reaching a point in the atmosphere where the barometric pressure equalled one millimetre of mercury, have a velocity of only 28,968 metres per second. On reaching a point where the pressure was 10 mm., the velocity of the meteorite would be only 5,916 metres a second; and on reaching a point of 100 mm. pressure, the velocity would have fallen to 506 metres per second. At the sea level the velocity would have fallen to five metres per second. Taking these results as representing the lowest estimate of the resisting effect of the air on the passage of meteorites, M. Govi calculates the number of heat-units or calories equivalent to the loss of kinetic energy or *vis viva* experienced by a meteor of 14·66 kilogrammes. When this meteor reaches a point of almost 1 mm. pressure, the loss of energy is equivalent to 2,921,317 calories, an amount of general heat more than sufficient to explain all the phenomena of light, heat, and mechanical movement seen in meteorites which penetrate the higher regions of the atmosphere.

ANOTHER Norwegian Arctic expedition will start in July next year to scientifically explore the seas between North Cape, Jan Mayen, Spitzbergen, and Novaya Zemlya, in order principally to determine the position of the isothermal line of 0° cent. at the sea-bottom, which may be taken as the northern limit of the wanderings of the cod-fish, which form the object of the spring and winter fisheries of Norway. Swedish Arctic expeditions have also of late years been of much scientific importance. They have proved a practical school to more than thirty naturalists, and furnished useful geological results, as well as stocking the national museums with the richest Arctic collections in the world. Economically, they have gathered valuable information for the seal and whale fishers, and led to the discovery at Spitzbergen of considerable seams of coal and of phosphate, which one day will be of great value to the neighbouring countries. They have also inaugurated the new maritime track to the mouths of the Siberian rivers the Obi and Yenesei, and started a new commerce. M. Nordenskjold believes that ships can pass in autumn from Norway to these rivers, or from the Pacific to the mouth of the Lena. Next year he intends to further explore the glacial sea of Siberia.

INVISIBLE INK FOR POST-CARDS may be made of a solution of nitrate or chloride of cobalt, or chloride of copper, mixed with a little gum or sugar. This ink becomes brown by warming. Ferrocyanide of potassium solution may also be used, but requires to be developed by a solution of copper or iron sulphate, which turns it blue in colour.

COLUMBIUM.—We shall soon hear of columbium plating, a metal which is very much like nickel, but whiter, like tin. It was first found more than fifty years ago in the United States, near Middletown, Connecticut, and named in honour of America. It was thus far very scarce, but has now been found at Marion, N. C., and also in the Amazon stone of Colorado. If it becomes abundant enough to be used in the arts, we may soon have a valuable addition to the useful metals, and also to their compounds or salts. The metal forms an acid like tin, called columbic acid. Tin forms what is called stannic acid, and the compounds of this acid with bases are stannates — very

useful in the arts; the compounds of co'umbic acid with bases must be columbates. They have not yet been investigated, but will be found extremely useful for some purposes.—*Manufacturer and Builder.*

SEA SOUNDING.—Sir William Thomson has recently patented an ingenious method of sounding, which can be put in practice without reducing a ship's speed. The pianoforte wire sounding apparatus of the same inventor was a great improvemt on the old fashioned lead-line, and has done good service in the American navy and on cable-ships, notably the s.s. *Hooper* and *Faraday*. By the wire-sounding apparatus a great deal of time is saved, owing to the small amount of friction of the sea water on the wire in sinking and in hauling in, as compared with the friction on the rough hemp surface of the lead-line. Owing to the speedy execution of a wire sounding, it was also possible in shallow water to take a series of flying soundings from a ship without slackening her speed as she approached the coast,—a great advantage to a mail steamer in thick weather. One objection to flying soundings by the wire exclusively, lay in having to take the great slant of wire paid out as a measure from which to deduce the depth, since owing to the ship's motion, it was impossible for the wire to drop vertically down to the bottom. The new invention of Sir William Thomson measures the depth independently of the wire paid out, which, however, may serve as a check on the other result. The pressure of the sea-water at the depth to which the lead sinks is made the means of registering the depth, in the following way. A glass tube closed at one end and open at the other, is lined inside with a colouring matter such as aniline blue, red prussiate of potash, or, better still, chromate of silver, which will be acted upon chemically, and discoloured by sea water. This tube, suitably guarded in a brass guard-tube against accidents, is lowered with the lead-line into the sea. The sea water, forcing its way into the tube by the open end, compresses the air-column therein, and mounts up the tube to a height corresponding to the pressure, and discolours the lining of the tube in its passage. The discolouration in the tube marks the height to which the sea-water has penetrated, and this becomes a measure of the water pressure, and consequently, by employing a suitable scale, of the depth in fathoms to which the lead was sunk. A chromate of silver lining of the tube is turned from orange yellow to white by the action of the sea-water. Instead of discolouring the lining by sea-water alone, the sea-water itself may be tinctured by a dye as it enters the tube; or it can be arranged by proper valves simply to trap the water in the tube, and retain it there until it can be brought to the surface and its height read off. The indicator tube and lead-line are used in conjunction with the pianoforte-wire apparatus. Recent trials of this new apparatus on board H.M.S. *Minotaur* have proved highly satisfactory.

SIR WILLIAM THOMSON at a recent meeting of the Shipmaster's Society, St. Mary Axe, described his plan for distinguishing lighthouses by means of the Morse code. Revolving lights are defective as a means of distinction, inasmuch as the light is generally only visible for 10 seconds or less before obscuration, and it is impossible to take its correct bearing. Coloured lights ought never to be used, because of the danger of mistaking them for railway or other ship's lights. Sir William Thomson's method, which has been found effective during the last three years on the Hollywood Bank light, Belfast Loch, consists in making the light-house regularly flash its distinctive letter or initials by the Morse alphabet by a series of long and short eclipses. The light is eclipsed by a revolving screen rotated by a train of wheelwork.

THE proposed pneumatic despatch system in Berlin will comprise 26 kilometres of tubing and fifteen stations. The bore of the tubes will be 65 millimetres. They will be of wrought iron and will lie about a metre below the surface of the ground. The letters and cards which are to be forwarded have a prescribed size, and are enclosed in iron boxes or carriers, each of which can hold twenty. From ten to fifteen carriers are packed and forwarded at a time, and behind the last is placed a box with a leather ruffle, in order to secure the best possible closure of the tube. The exhausting machines and apparatus required for the transmission are situated at four of the stations. Both compressed or rarified air, or a combination of the two, are employed in propelling the carriers. Steam engines of about 12 horse power are used in condensing or rarifying the air. Each of the four main stations have two engines, which drive a compressing and an exhausting apparatus. Large reservoirs are used for the condensed and rarified air. The tension of the condensed air is about three atmospheres, and that of the rarified about 35 millimetres of mercury. The condensed air, heated to 45° C. by the compression, is cooled in the reservoirs which are surrounded with water. The velocity of the carriers averages 1,000 metres per minute, and a train is despatched every 15 minutes. Each of the two circuits, into which the system is divided, is traversed in 20 minutes, including stoppages. The entire cost of the enterprise is estimated to cost 1,250,000 marks.

ASBESTOS promises to become a very useful material, owing to its indestructibility by fire or acids. In mechanical engineering it is coming more and more into use as a steam packing for piston and pump rods, felting for boilers, &c. In the wooden houses of America it is attracting attention as a fire-proof lining or wall paper; as it renders houses not only safer but cooler in summer and warmer in winter. Recent patents have registered its use as a fuel-bed for petroleum in stoves or engine furnaces. It absorbs the oil, which burns away, leaving the asbestos intact like an incombustible

wick. In Paris it is being adopted in the form of fire-proof writing paper in the public offices. As a decoration for theatres it may prove of great value in the future. It is chiefly obtained in the Italian Alps from veins in the Serpentine Rock, and has hitherto been sold at a price varying from £50 to £100 a ton according to quality.

Correspondence.

C. STEWART.—We are sorry to say that we have not received your book, but if you would send us another copy we shall be glad to notice it.

A. C. M. WEAVER.—The resistance of the voltaic arc has been ascertained by actual experiment to be about 30 or 40 ohms, consequently the current which passes in the circuit would be given by the expression

$$\text{Current} = \frac{E}{\text{(resistance of battery and leading wires in ohms)} + 30.}\text{ vebers.}$$

E being the electromotive force of the current in volts.

D.F.G.—Yes; the paragraph in "Hockin's Metre Resistance Bridge" should be, "In order to do this, remove the coil R′ (*not* R R′), and substitute for it a thick bar of copper."

The working out of the formulæ may possibly be clearer to you if put in the following manner:—

* * * When no current passes through the galvanometer, then 1000 mm. being the length of the wire, the portion between r and E will be $1000 - x$, consequently we have the proportion—

$$R + r + x : 1000 - x + r' :: a : b$$

by multiplying up

$$(R + r)\,b + xb = (1000 - x)\,a + r'a \qquad (A),$$

or

$$(R + r)\,b = a\,(1000 - x) - xb + ar$$

that is

$$R + r = \frac{a}{b}(1000 - x) - x + \frac{a}{b}r'$$

or

$$R = \frac{a}{b}(1000 - x) - x + \frac{a}{b}r' - r.$$

This expression for finding R, as is explained in the paper, requires that r′ and r should be known. In the following method a knowledge of these quantities is not requisite.

Having taken the measurement in the manner described, substitute a thick bar for the coil R, and again obtain equilibrium by adjusting the slider. Let the new reading on the scale be x'. Then

$$r + x' : 1000 - x' + r' :: a : b,$$

therefore

$$rb + x'b = 1000\,a - x'a + r'a,$$

and from equation (A) we have

$$Rb + rb + xb = 1000\,a - xa + r'a$$

by subtracting one equation from the other we have

$$Rb + xb - x'b = -xa + x'a,$$

or

$$Rb = a\,(x' - x) + b\,(x' - x),$$

that is

$$R = (x' - x)\,\frac{a + b}{b}$$

if we have a equal to b, then we get the extremely simple result

$$R = (x' - x)\,\frac{a + a}{a} = 2\,(x' - x).$$

That is, R will be equal to twice the length of wire between the two positions occupied by the slider in the two measurements.

The equations at the end of the article are thus arrived at:

From the equation

$$\frac{r + x}{r' + 1000 - x} = \frac{a}{b}$$

by multiplication we have

$$rb + xb = r'a + 1000\,a - xa \qquad (B)$$

therefore

$$r'a = rb + xb - 1000\,a + xa$$

or

$$r' = \frac{rb + xb - 1000\,a + xa}{a}$$

similarly from the equation

$$\frac{r + x'}{r' + 1000 - x'} = \frac{b}{a} \qquad (C)$$

we get

$$r' = \frac{ra + x'a - 1000\,b + x'b}{b}$$

therefore

$$\frac{rb + xb - 1000\,a + xa}{a} = \frac{ra + x'a - 1000\,b + x'b}{b}$$

or

$$rb^2 + xb^2 - 1000\,ab + xab = ra^2 + x'a^2 - 1000\,ab + x'ab$$

that is

$$ra^2 - rb^2 = xb^2 + xab - x'a^2 - x'ab$$

or

$$r = \frac{(a + b)\,(bx - ax')}{a^2 - b^2} = \frac{(a + b)\,(bx - ax')}{(a + b)\,(a - b)} = \frac{bx - ax'}{a - b}.$$

To obtain r′ we have from equation (B)

$$r = \frac{r'a + 1000\,a - xa - xb}{b}$$

and from equation (C)

$$r = \frac{r'b + 1000\,b - x'b - x'a}{a}$$

therefore

$$\frac{r'a + 1000\,a - xa - xb}{b} = \frac{r'b + 1000\,b - x'b - x'a}{a}$$

or

$$r'a^2 + 1000\,a^2 - xa^2 - xab = r'b^2 + 1000\,b^2 - x'b^2 - x'ab$$

that is

$$r'a^2 - r'b^2 = (1000 - x')\,b^2 - (1000 - x)\,a^2 - abx' + abx$$

or

$$r' = \frac{(a + b)\left\{b\,(1000 - x') - a\,(1000 - x)\right\}}{a^2 - b^2} = \frac{b\,(1000 - x') - a\,(1000 - x)}{a - b}.$$

We hope this will make the matter clear to you; if not, we shall be glad to afford you any further explanation you may require.